Appendix E

PREDRAINAGE LANDSCAPE ECOLOGY AND HYDROLOGY OF THE ST. LUCIE WATERSHED ESTIMATED FROM HISTORICAL SOURCES

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INTRODUCTION

This report was researched and written in response to a request for information from Dan Haunert, Upper East Coast Division, South Florida Water Management District. Objective of this time-limited study was to develop a sense of predrainage hydrology of the St. Lucie River watershed, based on understanding of the area's predrainage landscape ecology. Source materials included satellite imagery (**Figure E-1**), U.S. Government Land Office (GLO) township surveys from the 1850s, field notes from the same township surveys, knowledge of drainage history, maps of the present drainage system, USGS topographical maps, maps from the 1940s of vegetation and soils, and knowledge of remaining "natural" areas. Contour maps of elevation at 1 foot resolution would have been very useful, but were not available. The approach is deductive, using multiple sources of landscape information to piece together a predrainage picture consistent with all available information.

The following questions were to be addressed:

What spatial patterns were present within the watershed?

What directions might water have drained under natural conditions?

What were the relative contributions of the North and South Forks of the St. Lucie River?

Ideally, these questions would be answered from direct observations of predrainage hydrology, e.g., water depths during the course of the year, durations of above ground water, observed flow directions, etc. As it was recognized that such direct observations were unlikely to be available, at least in sufficient numbers to cover the whole watershed, indirect approaches based on landscape ecological knowledge were encouraged. Predrainage vegetation and soils, when known, can be useful indicators of predrainage hydrology, particularly if additional topographical information is available to position the vegetation types and soils within the landscape.

It is important to recognize from that outset that, by all indications, the St. Lucie watershed has been extensively and intensively influenced by drainage. Almost every square mile is traversed by numerous drainage canals and ditches (**Figure E-2**). It is also important to recognize that historical information (e.g., Randolph & Co. *et al.* 1919), as well as the accessibility of the landscape suggest that significant drainage was in place well before the

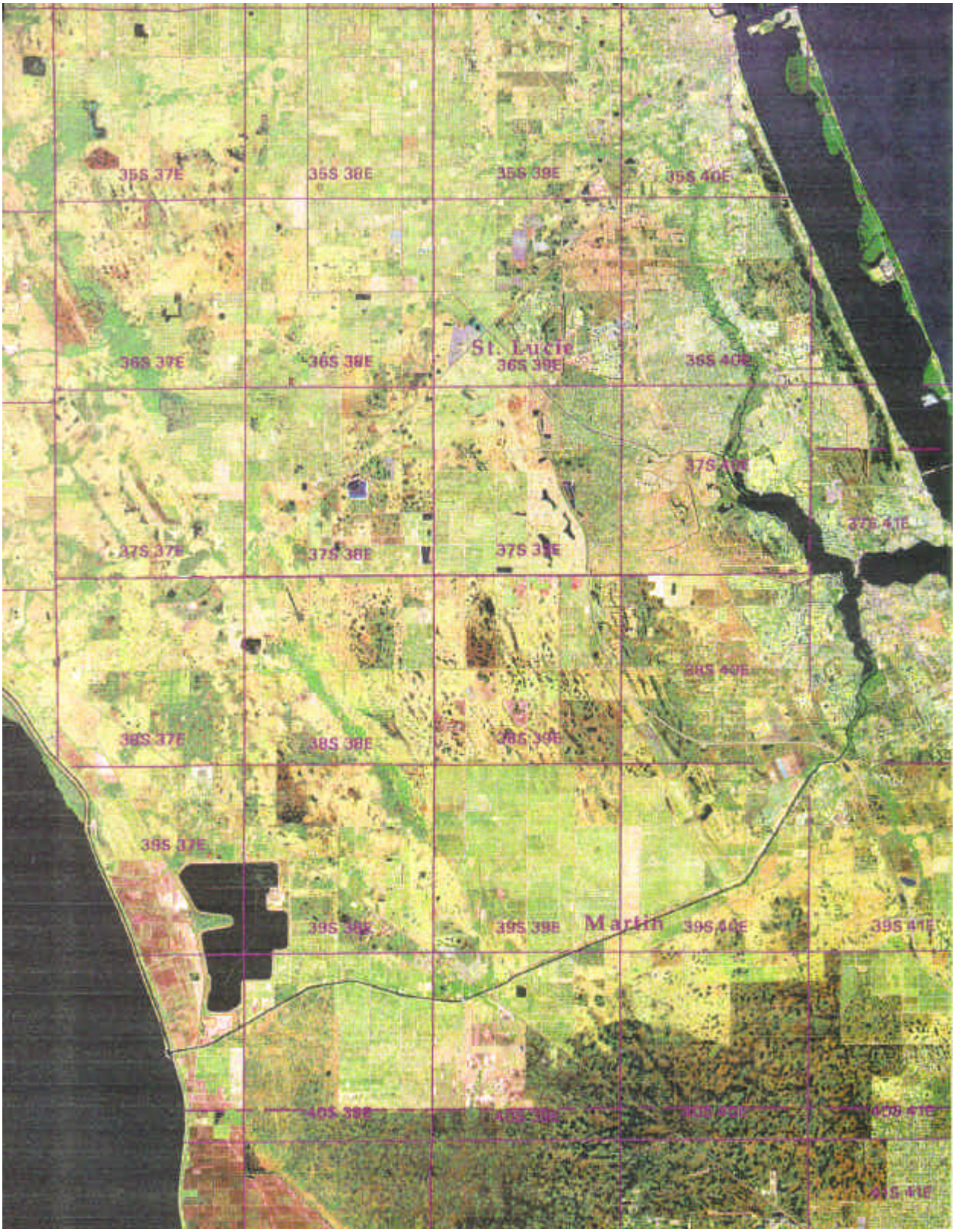

Figure E-1. Satellite Image of Majority of the St. Lucie River watershed, Overlain with Township Range Grid. Note relation of land use to T R grid.

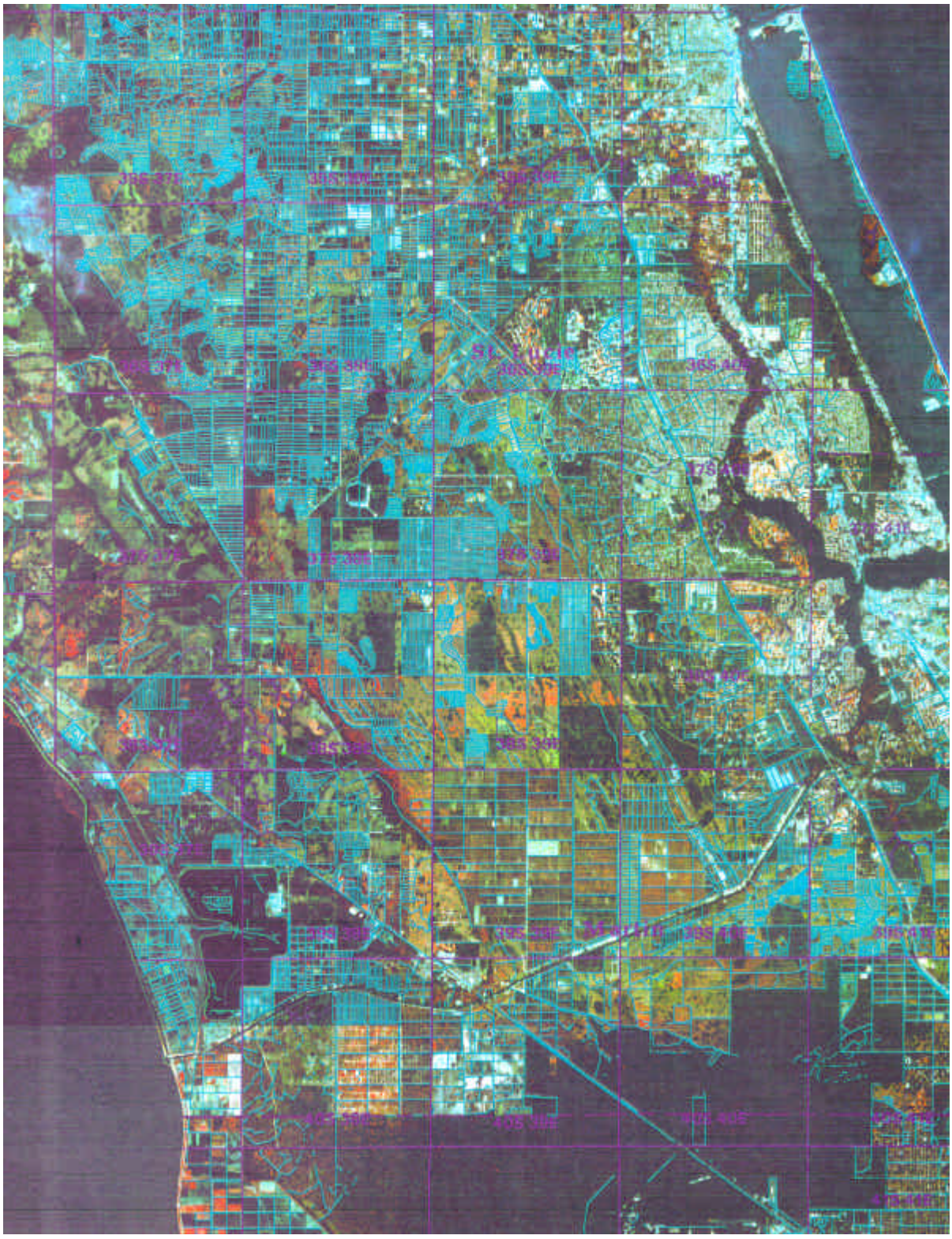

Figure E-2. **Satellite Image of Majority of the St. Lucie River Watershed, Overlain with Current Canal System and Township Range Grid.**

1940s. Substantial and significant landscape change almost certainly accompanied this drainage. Peat soils in this area originally accumulated in low spots in the underlying sand, due to prevention of oxidation by standing water present during much of the year. Once drainage had lowered water tables below the land surface, complete loss of the peat could easily have occurred within a few decades (Stephens and Johnson 1951), as these soils were generally not more than a few feet deep.

The ephemeral nature of shallow peat soils in South Florida, once drainage is initiated, has important implications for understanding predrainage landscape ecology and hydrology. The flatness of the area, combined with the quantities and timing of rainfall that originally kept the water table close to ground surface, means that variations of only a few feet create the difference between upland pine or oak-cabbage hammock areas on a sand or loamy sand substrate and wetland swamps or sawgrass ponds on a peat substrate. If drainage causes the low-lying peat soils to completely oxidize away, the newly exposed underlying sand can come to resemble the sandy substrate of the original (predrainage) upland areas. Wetland and upland areas, once easily distinguishable, can blur, with upland vegetation starting to appear throughout. This is not surprising; in a sense it is the intended objective of drainage – to transform "swampland" into habitable or cultivatable "uplands."

The significance of the ephemeral nature of organic (peat) soils after drainage for correctly understanding predrainage ecology and hydrology is that it means that soil mapping carried out after drainage has begun cannot be assumed to reliably indicate the presence of predrainage wetlands. At best, post-drainage maps will underestimate the area of wetlands; at worst they can misleadingly indicate complete absence of wetlands if all peat has been lost.

As a result of the above, vegetation maps from the 1940s (e.g. Davis 1943), soil maps from the 1940s (Jones et al. 1948), present day soil maps, and present day satellite images all are inherently unreliable indicators of the predrainage landscape patterns within the St. Lucie watershed. These sources can provide very useful leads and suggestions of predrainage conditions, but the information must be carefully interpreted, using predrainage information that includes spatial detail.

Cursory inspection of a number of GLO township survey maps (**Figure E-3**) from within the watershed indicated that most of the area originally formed a mosaic, with multiple elements present within a square mile. Current topographic maps (**Figure E-4**), satellite imagery and the Davis (1943) vegetation map (**Figure E-5**) tended to confirm presence of a mosaic. In light of this, the original questions were necessarily modified as follows:

What were the main two or three elements composing the predrainage mosaic?

Was the mosaic random in orientation, or did elements form an organized pattern?

Was the mosaic different in different parts of the watershed?

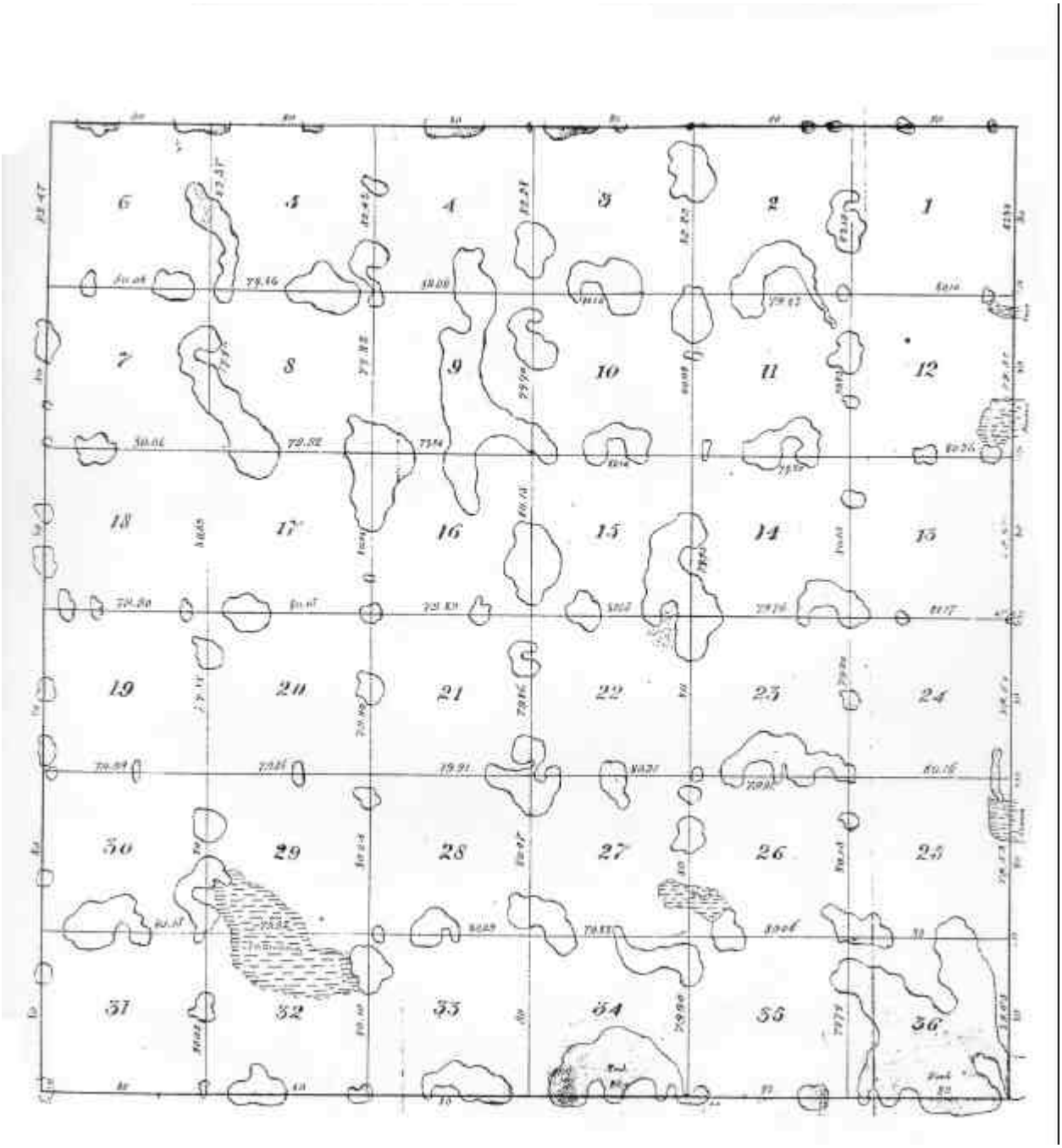

Figure E-3. **Sample Township Plat Map of Township** 38 **S., Range** 39 **E., Surveyed by M. A. Williams in May & June of 1853. Open polygons are "Ponds," probably open water ponds, in a few cases labelled in the field notes as "Saw Grass Ponds."**

Figure E-4. **U.S. Geological Survey Topographical Map of Township** 38 **S., Range** 39 **E, Photorevised in 1983. Presence of wetlands matches those drawn 130 years earlier on township plat (**Figure E-3**) along the surveyed Section lines. However, topographical map shows additional wetland extent within Section interiors, as well as wetland orientation, NW-SE. Note coincidence of drainage ditch network in Sections 29 and 32 with area marked "Savanna" on Township plat (**Figure E-3**).**

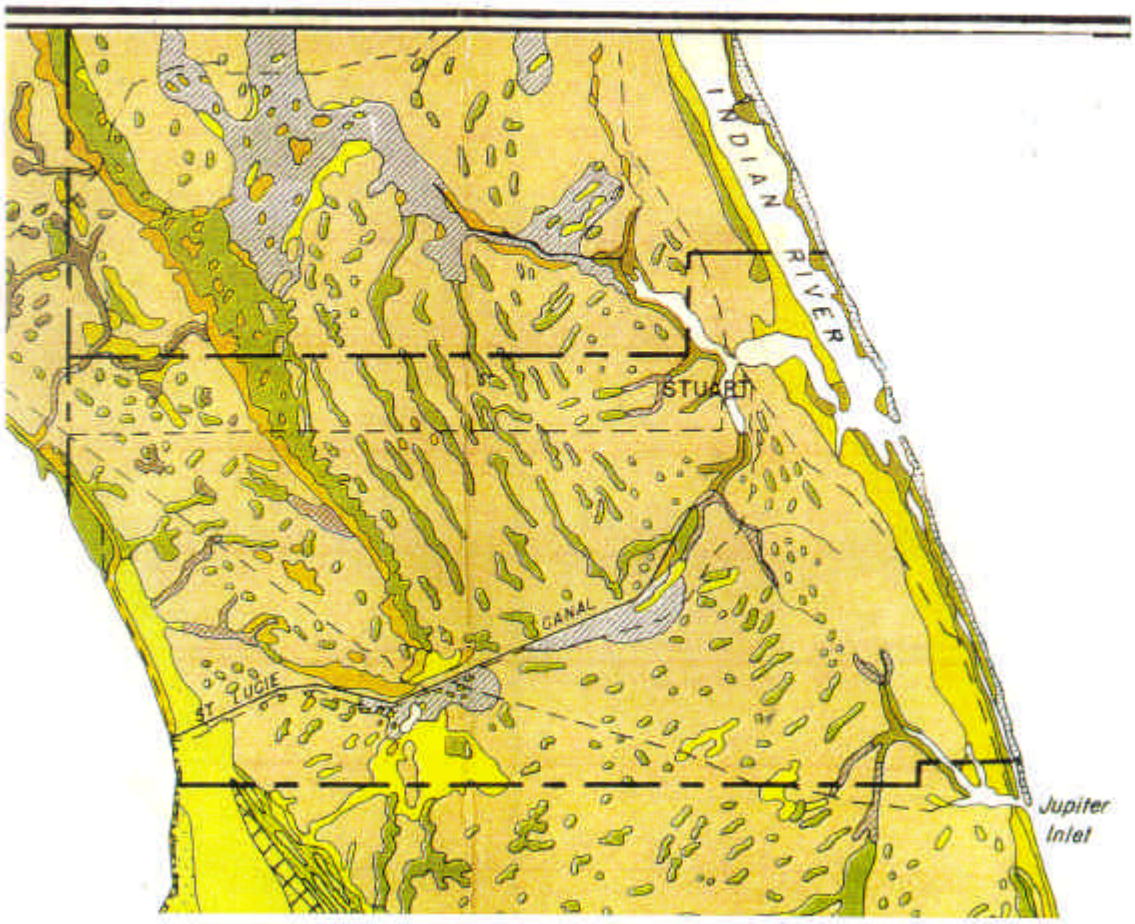

Figure E-5. **St. Lucie Watershed Portion of "Vegetation Map of Southern Florida" (Davis 1943).**

METHODS

This brief reconnaissance study was initiated by examination of a satellite image overlain with a township range grid (**Figure E-1**). By inspection, four townships ranging from north to south within the watershed were selected, based on the remaining presence of original mosaic pattern (townships outlined in red on **Figure E-1**). The four townships were also selected for their alignment with the prevailing NW-SE pattern, possibly related to relict sand dunes. It was necessary to include an additional southern township (Township 40 Range 38), as field notes were not available on site for T 40 R40.

Each of these five townships (36 square miles each) was "sectioned," that is, walked along the boundaries of each square mile, with vegetation and presence of water bodies measured and described, between 1853 and 1855. Three different Deputy Surveyors were involved, all under the same State Surveyor General, John Westcott. I examined each of the five plat maps (scale 2 inches = 1 mile), and used the section boundaries to compare them with current USGS topographical quadrangle maps (scale 2 5/8 inches = 1 mile) (Compare for example **Figures F-3** and **F-4)**.

The field notes available for four of the five townships were then read (84 linear miles for each township) and compared with the plats to develop a sense of the mosaic elements present within each township. Three aspects associated with mile were examined: (1) the transitions between different elements (e.g., "33.00 [chains] exit Pine, enter Saw Grass Pond"), (2) the species of witness trees noted to locate the section and quarter section marker posts, and (3) the overall description included at the end of each mile (e.g., "3rd Rate Pine[, Saw] Palm[etto] & Ponds"). Given the time limitation, the examinations of the field notes were necessarily qualitative, rather than quantitative.

A separate second effort examined township plats located in the "Allapattah Flats" area along the eastern foot of the NW-SE ridge forming the western boundary of the watershed. This area was originally called "Halpatta Swamp" (Williams 1853) and "Alpatiokee Swamp" (Fla. S.G.O. 1853). Comparison of township maps with satellite imagery (**Figure E-1**) and with the Davis (1943) vegetation map (**Figure E-5**) suggested that much of the original extent and character of the Halpatta Swamp area had already been lost or altered prior to 1943, leading to an underestimate of this area.

A third effort compared township plat maps in the headwater areas for the North and South Forks of the St. Lucie River.

Written records of the area presently known to the author were examined; considerably more narrative material is almost certainly available, but was not researched within the present timeframe.

RESULTS

General

A rough map (Fla. S.G.O. 1853) compiled by the Surveyor General's Office in St. Augustine shows both the South and North Fork of the St Lucie River draining from an approximately 400 square mile area labelled the "Alpatiokee Swamp" (**Figure E-6**). Plat maps and field notes for several of the townships mention a "Halpatta Swamp" and an "Alpatiokee Swamp." Further research would be needed to determine if these were alternate names for the same natural feature, or two separate features. As has often been the case in post–drainage South Florida, place names have changed as the landscape becomes drier under drainage. The current label "Allapattah Flats" is a post-drainage name certainly derived from Halpatta or Alpatiokee Swamp, but the area is no longer wet enough to be referred to as a "swamp" (much of it is now cultivated as citrus groves).

A map compiled in 1913 by the Florida Geological Survey on a base map by the U.S. Geological Survey (Matson *et al.* 1913) labels the South Fork of the St Lucie River as "Halpatiokee R.," suggesting a link with a Halpatta or Alpatiokee Swamp(s).

In a letter to Dr. V. M. Conway, Surveyor General of Florida, George MacKay, a U.S. Deputy Surveyor of many townships in southern Florida, wrote the following regarding what appears to be the St. Lucie River watershed:

> The country is generally poor land. Immediately on the Indian River Lagoon, it is low oak scrub & on my west line, it is open pine prairie, and saw grass savanna. Small pine scrubs. The savannas are the best land, tho' in the rainy season of the year they are covered with water. The --?-- --?-- entirely dry, and present a pleasing view. (MacKay 1846).

Mackay mentions the "sawgrass savannas" as the "best land" probably to contrast them from the common "3rd Rate Pine Lands" of Florida, found on sand with little native fertility. "Best" very likely refers to the presence of a top layer of organic peat soil, accumulated from wetland sawgrass growth. If this is the case, it would indicate that hydroperiods were probably 8-10 months of the year, such that the rate of organic matter accumulation slightly exceeded the rate of oxidative loss during the few months when standing water was absent. These also appear to be the optimal conditions for sawgrass; presence of peat soil, and water throughout most, but not all of the year.

In 1882, the Trustees of the Internal Improvement Fund, State of Florida, employed Silas L. Niblack as Agent to examine,

> The lands granted to the State of Florida as Swamp [and Overflowed] lands under the Act of September 28th, 1850" … [such examination being] "for the purpose of ascertaining the general character of the Swamp lands … with respect to their ability to overflow … and what proportion of said lands are already high and dry enough for cultivation… (Anonymous 1882).

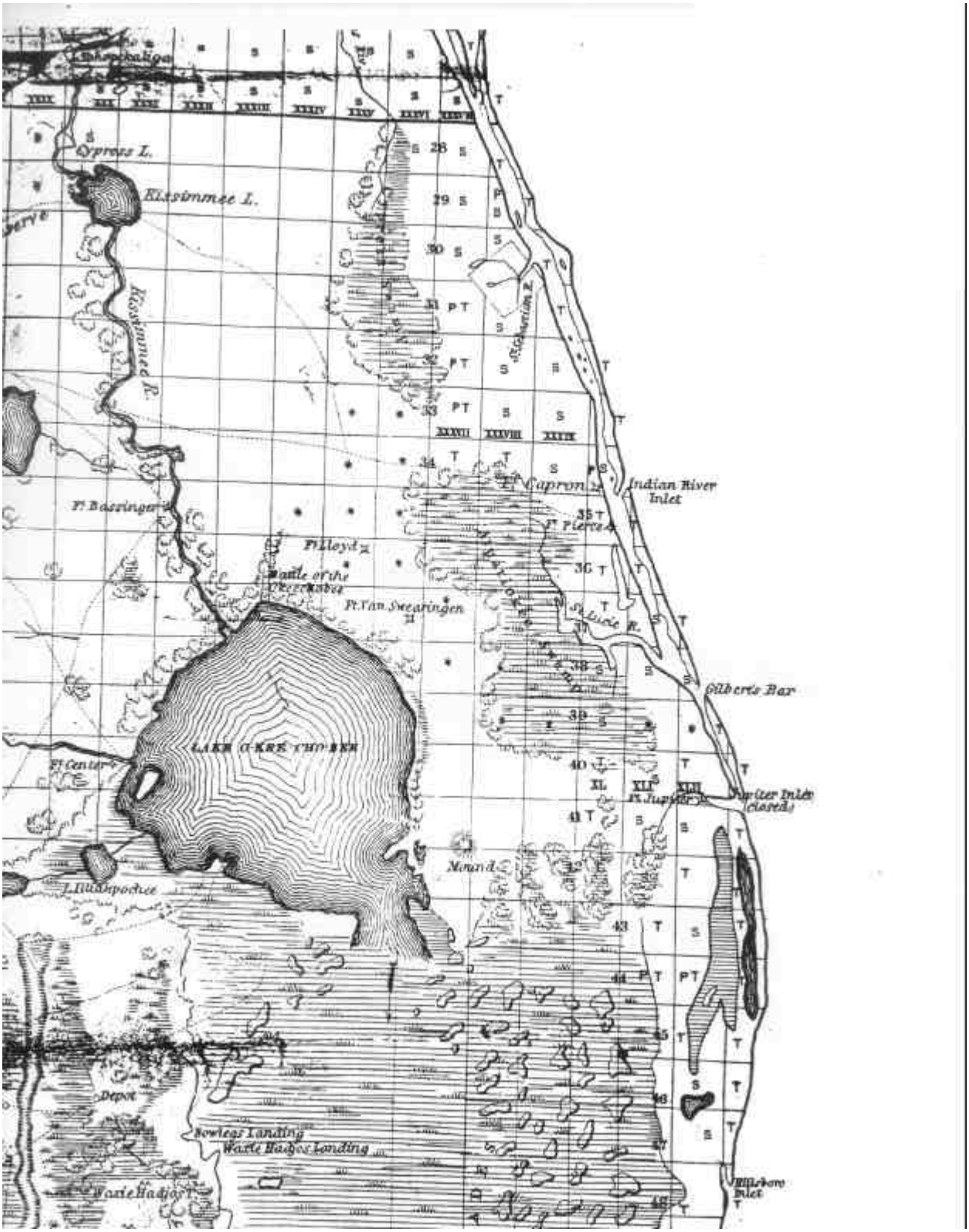

Figure E-6. **U.S. Bureau of Topographical Engineers Map of Southern Florida, 1853, Showing "Alpatiokee Swamp" as Headwaters of North and South Forks of St. Lucie River.**

Niblack's report of June 1882 states that "the balance of the land in Dade County would come within the terms of your drainage contract." (Niblack 1882). Niblack is stating that the whole St. Lucie watershed was in fact subject to overflow; Dade Co. at that time extended much farther north than at present. "Balance" refers to all of Dade County except the high ground near the New and Miami Rivers.

Even in adjoining, higher elevation pine lands, dry ground was the exception to the rule:

> Within this limit there is in the neighborhood of Fort Drum [T 34 R 35] a pine ridge about five miles in length and 1/2 to 3/4 mile in width, that might be, with light drainage cultivated; there is also near Taylor Creek a small ridge of Pine land that during a dry season might be cultivated, but subject to overflow in a wet season (Niblack 1882).

Niblack concluded by writing,

> I give it as my opinion and views resulting from examination and information received, [that] it is not advisable to have a … survey made of the State lands within said limits and a list prepared designating those not subject to overflow… [because] … I am satisfied the quantity of land not now subject to overflow, would be so small it would not pay the State the expense of examination and survey (italics added; Niblack 1882).

In 1919, two engineering firms, Isham Randolph & Co, Consulting Engineers, and Cunningham and Hallowes, Chief Engineers, issued a report and Plan of Reclamation for the North St. Lucie River Drainage District (Randolph *et al.* 1919). This drainage district (Townships 35 and 36, Ranges 38, 39, and 40) lies in the NE portion of the St. Lucie watershed (**Figure E-1**). We quote extensively from their report, as it gives a good sense of the landscape and landscape elements mapped by the township surveyors. Note however, that inspection of township maps from throughout the St. Lucie watershed indicate that the North St. Lucie Drainage District portion included a higher proportion of "Prairie" landscape than the rest of the watershed:

> The lands within the District may generally be described as flat, although elevations vary from fourteen to twenty-four feet above sea level. The highest lands are the pine woods which lie principally in the eastern half of the District. The prairie lands which are located mainly in the western portion of the district are flat, but there is a general slope from all portions of the District to Ten Mile Creek and Five Mile Creek and to the North Fork of the St. Lucie River, which is formed by the confluence of the first two named streams. These streams together afford the existing natural drainage outlets for the lands within the District as well as for a large body of prairie land lying further west. (Randolph *et al.* 1919).

The pine woods referred to on high ground in the eastern portion were probably associated with the Atlantic Coastal Ridge. This is in contrast to much of the rest of the St. Lucie watershed, where pines formed part of a mosaic landscape of "3rd Rate Pine and Ponds." The statement that Ten and Five Mile Creeks are the natural drainage outlets for the North district and even for the prairie lands further west is no doubt true. However, further research would be required to determine whether water reached the creeks primarily as surface water or as (shallow?) ground water flow. Three points suggest an important contribution of groundwater: (1) A later statement by Randolph *et al.* (1919) concerning the "lack of natural drainage" in the prairies; (2) apparent

absence, at least in some areas, of a clear pattern of directionally connected surface wetlands; and (3) the presence of a soil layer of lower hydraulic conductivity several feet below the upper, more conductive sand horizon:

> SOIL AND VEGETATION: ... The soil of the District consists of Hammock, Muck, Prairie and Pine lands. Approximately ninety percent of the lands are underlaid with a marl or clay subsoil, at a depth of from one to four feet. Probably three percent of the lands are underlaid with hardpan, and the balance has a subsoil of sand. (Randolph *et al.* 1919).

Modern soil surveys should be consulted to confirm the widespread presence of a marl or clay subsoil. If present, such subsoil would provide high water holding capacity as well as a restriction to rapid downward drainage of water, tending to create consistent baseflow from the watershed, rather than the more transient, "spikier" groundwater discharges associated with a completely sandy profile.

> PRAIRIE: The District includes 40,418 [out of 75,000] acres of prairie land. These are lands, usually very level, which through lack of natural drainage in the past have been so wet as to prevent the growth of trees. The existing vegetation is confined to native grasses, which make a luxuriant growth where water does not stand for too long a period. These lands have a general top soil of heavy sandy loam, underlaid with clay or marl. They respond readily to drainage, and private operations on limited tracts have indicated them as well adapted for groves or general crop production. The fact that no clearing [of trees] is required in developing these lands is a consideration in determining their present and future value. (Randolph *et al.* 1919).

As sawgrass is not specifically mentioned, it is not clear to what extent this corresponds to the "saw grass savannas" mentioned by MacKay (1846), or to more of a wet prairie environment of some combination of spike rush (*Eleocharis*), beak rush (*Rhynchospora*), Maiden cane (*Panicum hemitomon*). "Luxuriant growth" is suggestive (but not conclusive) of saw grass. Reference to absence of vegetation where water "stands for too long a period" probably refers to the open water ponds depicted on all township plat maps I examined within the St. Lucie watershed.

In some parts of the prairie landscape, depressions were apparently deep enough to allow accumulation of significant peat soil deposits:

> In isolated tracts where local depressions in the prairie lands have brought about conditions favorable to a rank growth of [water] lilies, Maiden cane and other water grasses, a cover of well rotted muck varying from a few inches to six feet in depth is found. As at least the upper portion of the muck is ordinarily dry for a considerable part of each year, oxidation and decomposition of the vegetable matter has proceeded to an advanced degree, and the result is a soil which may be made highly producive by proper handling. (Randolph *et al.* 1919).

The description of open ponds (10% of the North St. Lucie River Drainage District) suggests sand-bottomed areas with sparse vegetation, perhaps 8-10 months of standing water, and maximum depths of 1-2 feet of water:

> OPEN PONDS: 7,270 [out of 75,000] acres of land in the District consists of open ponds. These lands similar in general nature to the prairie lands, but which are of such elevation

> as to be covered with a shallow depth of water for the greater portion of the year. For this reason the growth of vegetation in the past has been light and the top soil is of correspondingly poorer nature. These ponds are all of such elevation as to permit complete drainage under the Proposed Plan of Recommendation. (Randolph *et al.* 1919).

Absence of ponds on satellite imagery in areas where they had originally been shown on township maps suggests that Randolph *et al.* (1919) predicted correctly; sufficient man-made drainage was achieved to lower the water table below even the bottom of the pond elevations. Water tables were apparently lowered enough that both higher ground and former ponds could be farmed equally. (Note: there is little doubt that most predrainage ponds have disappeared, but land leveling, not just drainage alone, may have been partially responsible for this; pers. comm. K. Konya, 21 Nov., 2000)

Township Maps

The following section focusses on detailed examination of a series of five townships extending NW to SE through the St. Lucie watershed. All township plats examined showed evidence of the mosaic nature of this region, mostly "ponds" within a matrix of less wet vegetation. Some plat maps also showed regional features, such as the Halpatta Swamp (Allapattah Flats), consisting of "impracticable" sawgrass and bordering "Bay Galls," "Swamp," or "Savanna"). Interestingly, the ponds were usually drawn as features about $1/8^{th}$ to 1/4 of a mile across, and curiously lined up in north-south and east-west rows. Probability aside, the satellite imagery and the topographic maps clearly indicate that these neat rows do not accurately depict the original landscape. Detailed comparison of individual square mile sections between the township plats and the topo quads shows that the township surveyors tended to draw disconnected, circular ponds centered on the section lines (**Figure E-3**; see for example Sections 7 and 8), whereas in actuality the ponds had more complex shapes (**Figure E-4**). Actual ponds often extend, and presumably extended, NW to SE, and crossed two or more section lines. As the surveyors only walked the borders of the mile square sections, and did not have the benefit of aerial views of the landscape, they often incorrectly drew larger, rambling ponds as a series of circular, independent ponds, not realizing that they were in fact connected. From this I conclude that the township plats are not a reliable way to estimate the fraction of the mosaic occupied by ponds.

Evaluation of the landscape fraction occupied, prior to drainage, by ponds is best done using the topographical maps and/or the satellite imagery. (Note however that comparison of two different satellite images, taken at different times, suggested that the size of these ponds can change significantly as water levels rise and fall.)

No water depths or mentions of duration of standing water (hydroperiod) were found in the field notes for these townships. One mention of stream flow direction was found. An important limitation of this analysis of the watershed and these township survey results is the author's lack of having explored the area on foot.

Although streams were generally drawn on township maps, only one was found connecting between ponds within the St. Lucie watershed. (However, many streams connecting ponds are shown on township plats from within the high ridge area to the west of the watershed.) Shape of

the ponds, when examined jointly on topographical maps as well as the township plats, generally did not suggest strong inter-pond connections, although this varied somewhat between townships. Overall, the impression was one of a landscape drained more by slow groundwater flow than by surface runoff. Ten Mile Creek, contary to expectations, was found not to extend much further on the plat maps than it currently does on topographic maps.

Township 36 Range 37

The southwestern corner of this township bordered the western ridge, and included what appeared to be a northern portion of the Halpatta Swamp (Allapattah Flats) area. This portion of the Hallapata Swamp included three separate areas of "Hammock" in a NW-SE line, as well as some "Swamp," "Bay Swamp," and "Low Prairie" area. Interestingly, this same western area now appears to have become wetter (used as a local detention basin??); the topographical maps currently show it as cypress swamp, rather than as hammocks. The majority of the Twp was labelled "Prairie." It is not exactly clear what "Prairie" refers to, but it appears to have included some pine, saw palmetto, and Cabbage Palm. Pits and mounds were used to mark some Section corners, apparently because no witness trees were available. Sawgrass ponds were scattered throughout the Prairie area. The Jones Hammock and North of Bluefield (Okeechobee 1 SE) USGS topo quads show a considerable number of isolated wetlands (former sawgrass ponds??), as well as a number of networks of drainage ditches. Elevations in the township ranged from 25 to 30 feet above sea level. Landscape categories reported in the GLO field notes for Township 36 Range 37 are presented in **Table E-1**.

Table E-1. **Landscape Categories Reported in the GLO Field Notes for Township 36 Range 37. Surveyed by C. F. Hopkins in July 1853.**

Surveyor's Name	Witness Trees	Comments
"3rd Rate Prairie", "3rd Rate Pine & Palm[etto] Prairie"	Pits, Cabbage [Palm], Pine	Matrix over most of Twp. Includes: Sawgrass Ponds, Pine Islands
"Saw Grass Ponds"	--	More scattered wetlands (ponds?) shown on USGS topo than on twp plat – significant?
"Pine Islands," "Pine Lands"	Pine	Considered as distinct inclusions within "Prairie"; Match well w/ forested areas on topo
"1st Rate Hammock"	Oaks, Cabbage Palms, Ash (1)	Occurred as northern extension of Hallapata Swamp, NW-SE; Probably rich soils
"Swamp"	Cypress	Two smaller areas; W side of Twp
"Bay Swamp," "Bay Gall"	Bay	Small; W side; w/ Low Prairie, Swamp
"Saw Grass Marsh"	-	One small area only

Township 37 Range 38

Western half of Twp was all "Saw Grass" and "Savanna" – part of the Hallapata Swamp feature. Eastern half was matrix of "3rd Rate Pine" with inclusions of numerous "Ponds." As one pond was specifically labelled "Saw Grass Pond," I assume that the numerous others labelled only "Pond" were either too deep for sawgrass or too shallow to accumulate enough peat for sawgrass. Appears to be more Pine than in T 36 R 37, and fewer Cabbage Palms. Less developed

parts of Twp show wetlands throughout on USGS topographical quads Bluefield (Okeechobee 4 NE) and North of Bluefield (Okeechobee 1 SE); topo quads give wetter impression than the survey notes. The large Sawgrass area in Secs 31, 32, 30, 29, 19 (Hallapata Swamp/Allapattah Flats) is visible on topo quad; includes some forested area. Elevations in eastern half of Township (Pine Land) were 25 to 28 feet above sea level, mostly around 26 feet. Three "Flowing Wells" marked in eastern half. Landscape categories reported in the GLO field notes for Township 37 Range 38 are presented in **Table E-2**.

Table E-2. **Landscape Categories Reported in the GLO Field Notes for Township 37 Range 38. Surveyed by M. A. Williams in June 1853.**

Surveyor's Name	Witness Trees	Comments
"3rd Rate Pine & Ponds", "3rd Rate Pine & Rough Palm[etto]" (1)	Many Pines, A few Cabbage Palms	Matrix over East 1/2 of Twp. Includes: Ponds
"Ponds" "Saw Grass Pond" (1 only)	--	Vegetation unclear but either too deep for sawgrass; or too little peat for sawgrass
"Saw Grass"	--	17 sq miles; Hallapata Swamp
"1st Rate Hammock"	--	A few small hammocks within Sawgrass
"Savanna," "Wet Savanna"	A few Pines, 1 Cabbage Palm, 1 Myrtle	Along E side of Sawgrass; Intermediate between Sawgrass and Pineland??
"Bay Swamp," "Bay Gall"	Bay	Small; W side; w/ Low Prairie, Swamp

Township 38 Range 39

With the exception of one or two Twps on the southern border of the watershed, T 38 R 39 appears to be the least developed (**Figure E-1**), lending itself to comparisons between present day topo maps and the 130 year older township plat map. Regional drainage almost certainly affects the Twp, but local ditch systems seem to be less developed here than elsewhere in the watershed (**Figure E-2**). The survey notes are repetitively consistent, all "3rd Rate Pine & Ponds" with Pines as witness trees. Comparison of the Twp plat map (**Figure E-3**) with the USGS Indiantown NW topo quad (**Figure E-4**) suggests a close match in wetland delineation. The hammock found on the Section 15-22 border appears to still be present (benchmark elevation there of 31 feet above sea level). Elevations seem to indicate a very flat landscape, ranging from 29 to 31 feet, with the 30 foot contour line often being the coincident with the edge of the wetlands. The topo map also suggests that many of the wetlands are elongated and interconnected in the NW-SE direction. Green Ridge, reaching 35 feet, runs with the same NW-SE orientation through Sections 11, 13, and 24. A single note in the township survey, "18.00 [chains] to Pond Running Water E S E" (N boundary Sec 11 Course W), suggests that drainage from this location east of Green Ridge might proceed toward the South Fork of the St. Lucie River. Elongated, interconnected wetlands oriented NW-SE could be consistent with this, but no other flow information is available from the 1853 notes. Landscape categories reported in the GLO field notes for Township 38 Range 39 are presented in **Table E-3.**

Table E-3. **Landscape Categories Reported in the GLO Field Notes for Township 38 Range 39. Surveyed by M. A. Williams in May & June 1853.**

Surveyor's Name	Witness Trees	Comments
All "3rd Rate Pine & Ponds"	All Pines	Matrix. Includes: Ponds
"Ponds" "Saw Grass Pond" (1 only)	1 Bay, probably on edge	Vegetation unclear but probably deeper than Sawgrass; or too little peat for sawgrass
"Hammock"	--	One small hammock
"Savanna"	1 Pine, might have been outside	A few small areas

Township 40 Range 40

This Twp was chosen as approximately two-thirds of the Twp is undrained natural area, and therefore might provide a model for the predrainage condition of the more developed townships further north in the St. Lucie watershed. The West of Rood (West Palm Beach 2 NE) orthophotomap suggests that there might be an important difference from townships further north in the watershed as the wetlands in T 40 R 40 generally appear more circular, less directional and the regional pattern less oriented than was the case in T 38 R 39.

Although field notes were not available for this Twp (should be obtainable from Tallahassee), comparison of the plat map with the USGS orthophotomap confirmed that the plat map underestimates the large quantity of wetlands (which appear to be ponds with areas of cypress), showing only those crossed by the section lines. Comparison of Section 35 suggests a good match for those shown. Elevations range from 20 to 25 feet above sea level, with lower elevations to the NE.

Township 40 Range 38

This Twp was examined as a proxy for T 40 R 40, due to the local unavailability of field notes for latter. Information from two different surveyors is available for this Township; M. A. Williams surveyed the north boundary in August & Sept. of 1853 and W. J. Reyes surveyed the whole Twp in February 1855. Elevations 24 to 26 feet above sea level, with one isolated spot in NE corner of 30 feet. As for other townships, the topo maps (Port Mayaca and Barley Barber Swamp (Okeechobee 4 SE)), indicated many more wetlands than those shown on the Twp plat. The field notes indicate numerous wetlands, generally either "ponds" or "cypress swamps." This could be an underestimate, as this Twp appears to have been significantly affected by drainage. Landscape categories reported in the GLO field notes for Township 40 Range 38 are presented in **Tables E-4** and **E-5**.

Table E-4. **Landscape Categories Reported in the GLO Field Notes for Township 40 Range 38 (North boundary only). Surveyed by M. A. Williams in Aug. & Sept. 1853.**

Surveyor's Name	Witness Trees	Comments
"3rd Rate Pine", "3rd Rate Pine & Ponds"	Pines	Includes Ponds
"2nd Rate Hammock"	Cabbage Palm	"Cabbage Hammock"
2nd Rate Pine & Cabbage & Hammocks & Sawgrass Ponds"	Pine, Cabbage	Includes: Sawgrass Ponds, Hammocks; Cabbage appears to be mixed with pine
"1st Rate Hammock"	--	
"Savanna"	Cabbage Palms, Pines	

Table E-5. **Landscape categories reported in the GLO field notes for Township 40 Range 38. Surveyed by W. J. Reyes in Feb. 1855.**

Surveyor's Name	Witness Trees	Comments
"3rd Rate Cypress (Swamp), Pine & Palmetto		Inclusions: "Cypress Swamp", "Pine [Land]", "Ponds" (many; several per mile), "Sawgrass & Cypress (Pond)"
"Cypress Swamp"	Cypress, Pine, Cabbage, Bay, Myrtle	Many; probably as frequent as "Ponds"
"Pine [Land]"	Pine, Cabbage	
"3rd Rate (flat) Pine & Palmetto (land)", "3rd Rate Sawgrass Pine & Palmetto"	Pines, Cabbage	Inclusions: "Ponds" (many; several per mile), "Shallow Pond" (1), "Sawgrass"
"2nd Rate Pine & Cabbage"	Pines	Inclusions: "Ponds" (many; several per mile), "Willow Swamp" (1)
"Prairie"	Myrtle, Maple, Cabbage	Not much, but distinguished from "Sawgrass"
"Hammock"		Not many

Cross-Township Landscape Features

Figure E-7 shows a portion of the Halpatta Swamp (Allapattah Flats) that extended NW-SE across five townships. This area of "impracticably" dense and boggy sawgrass would originally have included peat soils and may have in part drained overland, along the NW-SE axis.

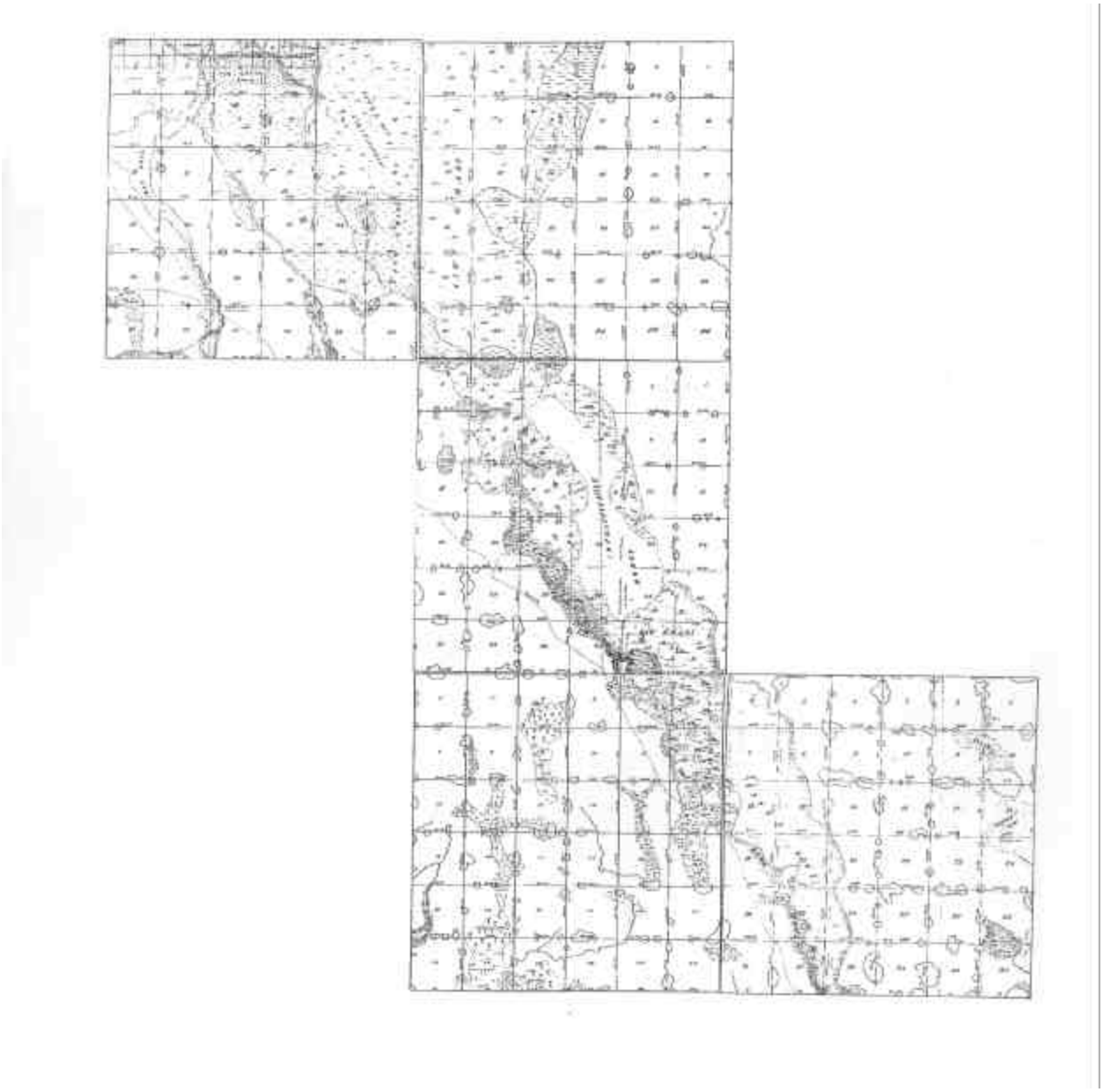

Figure E-7. **Mosaic of Five Township Plats from Townships 37 to 39 S., Ranges 37 to 39 E., Showing Extensive Sawgrass Marsh, Too Dense and Wet, Hence "Impractible" to Survey. Surrounding swamp, and perhaps sawgrass area as well, referred to as "Halpatta Swamp," Later Called the "Allapattah Flats." Much of original extent has disappeared under drainage and cultivation.**

Headwaters of the St. Lucie River

Figure E-8 is a township plat map that includes the South Fork of the headwaters of the St. Lucie River. It appears similar to the township plats mapping the North Fork (not shown; Townships 35 and 36, Ranges 39 and 40). It is tempting to assume that all of the "Prairie and Ponds" physiographic region present within the northern part od the watershed contributed surface run off to the North Fork of the St. Lucie River, and that the therefore flow through the North Fork was much greater than through the South Fork. While the North Fork likely passed more water than the South Fork, it is important to note that no actual evidence was found within the township survey plats or field notes documenting surface runoff. The difference between the two forks may be less than expected. There is some indication that the Halpatta Swamp / Allapattah Flats area may have been connected to the South Fork, but this certainly bears additional investigation.

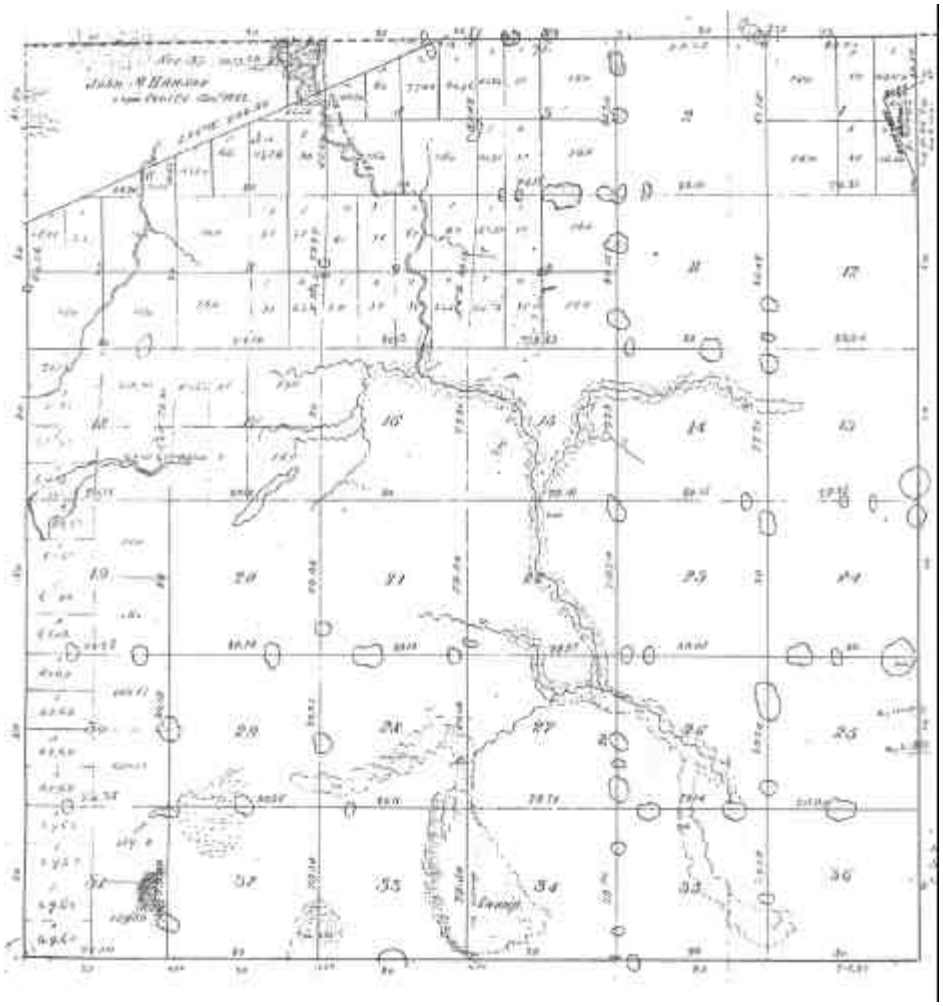

Figure E-8. **Township** 39 **S., Range** 41 **E., Showing Several Branches of the South Fork of the St. Lucie River. Surveyed by M. A. Williams in June 1853.**

CONCLUSIONS

The conclusions presented here are based on examination of field notes and plat maps, as described above, for five of approximately 30 townships making up the watershed. Plat maps for a number of additional townships were examined briefly. The author has not had the opportunity to explore the watershed in person.

Three main physiographic regions appear to have been present in the predrainage watershed: an area of Pine & Ponds mosaic, an area of Prairie & Ponds mosaic, and an area referred to as the Halpatta Swamp, later as the "Allapattah Flats." Ponds, whether of sawgrass, open water or "grassy species," appear to have been very common throughout the Pine and the Prairie areas. The difference in the non-pond "matrix" found in the Prairie compared to that found in the Pine areas is not completely clear, but the Prairie matrix appears to have been covered by standing water for longer periods each year, with as result a reduced density (in some places, complete absence) of pine trees.

All three physiographic regions appear to have been very flat, with the elevation difference between pineland and pond probably often as little as two feet. It is likely that the depths of the depressions varied, with the shallower depressions forming either open water or wet prairie-type ponds, and the deeper depressions accumulating peat deposits and supporting sawgrass vegetation. Once the deeper depressions had accumulated peat, the elevation difference between peat surface and surrounding pine land surface may have been similar to the elevation difference between pine land and the bottom elevation of the open-water, sand-based ponds.

The Prairie mosaic was described primarily in the northern portion of the St. Lucie watershed. The sawgrass marshes and bordering forested wetlands (Bay Galls and Cypress Swamps) that formed the Halpatta Swamp were present along the western edge of the watershed, along the eastern foot of the high NW-SE trending ridge. Cypress occurring in pond-like patches seems to have been confined to the southernmost townships of the watershed.

Although there appears to have been variation in spatial pattern and apparent interconnection between the ponds present in the watershed, generally there does not appear a strong suggestion of extensive connection nor of extensive surface runoff. The most important contribution of the watershed to St. Lucie River may have been more through groundwater contribution to baseflow than through surface runoff. The long duration of standing water in ponds and even longer duration in the sawgrass marshes may be of assistance in estimating duration of the baseflow recession during each year's dry season.

The presence of extensive surface water throughout the watershed, the probably limited degree of surface runoff, and examination of townships surrounding the headwaters of the North and South Forks of the St. Lucie River tentatively suggest that the difference in discharge between the two forks may be smaller than might at first appear.

RECOMMENDATIONS

It is suggested that this research be made available for critique and for use by a wider audience through publication in an appropriate technical journal. As this research effort was of very limited duration, it is suggested that prior to publication it be augmented by: (1) further examination of Government Land Office surveys of the remaining townships within the watershed; (2) identification and examination of additional predrainage narrative sources regarding the watershed; (3) examination of current county soil surveys covering the watershed; (4) ground inspection of selected areas including measurements of local topography and water depths; and (5) further investigation of watershed-scale patterns using estimated or measured topographical information at 1 foot resolution.

Prior to publication, the figures accompanying this report should be produced in electronic form, and enhanced for clarity (line quality, addition of watershed boundary, correction of spatial extent, format on page, etc).

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